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THE GARDEN CALENDAR

A radio discussion by W. R. Beattie and John R. Magness, Bureau of Plant Industry, delivered in the Department of Agriculture period of the National Farm and Home Hour, broadcast by a network of 48 associate NBC radio stations, Tuesday, February 21, 1933.

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SALISBURY:

We have something special for you on our garden calendar today and Mr. W. R. Beattie in charge as usual.

BEATTIE:

Hello folks. You may recall that on previous occasions I've told you about the work that Dr. John R. Magness and his associates are doing with apples, pears, peaches and other standard fruits, - getting the inside story of how the trees produce their fruit and what they require to make the best fruit. We've known that the growth of the trees has a lot to do with the size, quality and color of the fruit, but we didn't know all the factors involved. Isn't that true, Mr. Magness?

MAGNESS:

Yes Beattie, we've been trying to find how the tree works to built its fruit crop, and to find out just what each part of the tree does in producing the finished product, the fruit. The processes that go on within the tree are pretty complex, but if we once understand them we will know better how to manage our trees in order to get the best quality and regular production.

BEATTIE:

I suppose you study every part and function of the tree?

MAGNESS:

Yes, everything from the small feeding rootlets in the soil to the leaves, and the part that each plays in the production of fruit.

BEATTIE:

What part have you found to be most important?

MAGNESS:

All parts of the tree are important. But, from the orchardist's standpoint, I think the leaves are the most important. You see Beattie, the leaves manufacture the actual food materials responsible for the growth of the fruit and of the tree itself. No doubt you've often heard the leaves called the lungs of the plant. They're more than that. They are the food factories and the total of food the tree can form depends on the amount and the efficiency of its foliage. It is in the leaves exposed to the sunshine that the water brought up from the roots in the soil combines with the carbon dioxide of the air to form sugar.

BEATTIE:

And the sugar goes mostly into the fruit?

(over)

MAGNESS:

Yes, the sugar and other compounds that are formed in the leaves furnish practically all of the materials that go into the fruit except the water which amounts to about 85 per cent. The leaves also furnish most of the materials that make up the wood and bark growth. From this, you will readily see that the amount of growth of both the fruit and the tree is largely dependent upon the amount of leaf area in the orchard.

BEATTIE:

You mentioned carbon dioxide. How does it get into the leaves?

MAGNESS:

If you examined the lower surface of a leaf with a high-power microscope, you would see literally tens of thousands of small pores or openings, stomata they are called. The very minute quantity of carbon dioxide in the air - about 3 or 4 parts in 10,000 parts of air - enters the leaf through these pores. These pores close at night and open when the light strikes the leaf in the morning. The pores stay open during the day, provided all of the conditions are right.

BEATTIE:

What are some of these conditions?

MAGNESS:

Well, the moisture supply in the soil is one. Whenever the water supply in the leaves becomes a little short the pores close. We've found that if the weather is hot and dry, even though there is plenty of moisture in the soil, the pores on the apple leaves usually close about noon. If there is plenty of moisture and the day is cool and cloudy so that evaporation from the leaves is not so rapid, the pores will stay open practically all day. The point is just this, when the pores stay open the carbon dioxide from the air enters freely and the leaf functions 100 per cent in building food materials that go to produce fruit. The number of hours each day that the stomata remain open apparently depends to a large degree upon the amount of moisture that is available in the soil. If the soil moisture gets so low that the tree can not pick up water, the tree adjusts itself to less water by closing the stomata earlier each day. That means that less carbon dioxide is taken in and the growth of your fruit is checked.

BEATTIE:

I suppose that accounts very largely for the checking in the growth of the fruit during dry periods?

MAGNESS:

Exactly. In fact, we have been carrying on some very carefully controlled studies in the Potomac Valley of Western Maryland to determine the exact effect of moisture supply on the growth of the fruit. The soil in the orchards in which we were working was extremely dry during 1930 and again in 1932. Some of it has rather poor moisture-holding capacity, rather shallow, not over two or three feet deep and has a great deal of rock in it. In 1930, which was a very dry season, we found that the trees had pumped about all of the available water out of the soil by the middle of July.

BEATTIE:

Then what happened?

MAGNESS:

As more and more of the soil about the roots became dry, the period during which the leaf-pores stood open became shorter and shorter each day. About the middle of July they stopped opening entirely, and right then and there the fruit stopped growing. Then followed four weeks of dry weather during which the fruit stood still. The leaves stayed on the trees but the pores remained closed and apparently the leaves were not working at all. At the end of this four weeks we had a rain, and some cooler weather, and as soon as the water became available at the roots, the pores opened up again, the leaves began to function, the fruit began to grow and continued to grow for about three weeks. By this time the available moisture again was all pumped from the root zone of the trees, the pores closed, the fruit stopped growing and as there was no more rain the fruit made no further growth.

BEATTIE:

I suppose you had checks to determine the extent to which the lack of moisture affected growth?

MAGNESS:

Oh yes! Right alongside we had plots where we were watering the trees and keeping up the moisture supply, and the fruit grew at an even rate throughout the season on the trees that were watered. At picking time the fruit averaged less than half as large on the dry trees as it did on the irrigated trees. Apparently the fruit on the dry trees failed to grow, because the pores remained closed and the leaves were unable to build the sugars, the starches, and the so-called carbohydrate materials that go to make up the fruit.

BEATTIE:

Have you attempted to determine the amount of foliage necessary to produce a good, commercial-sized apple with color and quality?

MAGNESS:

Yes, we have. Before we started our research I had an idea that ten leaves would be plenty to build a good-sized apple. But, with ten leaves per fruit the trees produced apples that ran about 200 to the bushel, or a little below the border line for commercial fruit, that is hardly 2 1/4 inches in diameter. With 20 leaves per fruit we didn't quite double the size of the fruit but it ran about 150 apples per bushel. The fruit was also higher in sugar content and better colored. Then we went on up to 30 leaves per fruit and we got fruit that ran about 113 to the bushel or about double the size of the fruit the tree produced with 10 leaves per fruit.

BEATTIE:

Was there any difference in the growth of the tree under the different leaf area?

MAGNESS:

Oh yes. Where we had only 10 leaves per fruit, we didn't get fruit-bud formation on those branches for the next year, because all of the materials manufactured in the leaves apparently went into the fruit. The buds on those branches were small, and in no case did they form flowers for the next year. With 20 leaves per fruit we had an occasional fruit-bud formed for the next year, but with 30 to 50 leaves per apple, we got abundant fruit-bud formation with most varieties.

BEATTIE:

What varieties were you working with?

MAGNESS:

Our work included Delicious, Jonathan, Grimes Golden and others. With any variety we had to have at least 30 leaves per fruit before we got any appreciable bud formation for the next year. Many varieties required more than 30 leaves per fruit to form fruit buds. We have gone far enough in this work to show that the formation of fruit-buds for the season following is closely related to the amount of fruit and of foliage present on the tree.

BEATTIE:

Mr. Magness, I infer from what you have told us that the practical application of this whole matter from the fruit growers standpoint is that there is a definite relation between the moisture supply in the soil and the activities of the leaves on the trees and if the moisture supply is low on account of drought or lack of irrigation, the leaf pores close, the leaves cease to manufacture the foods required for growth and both the fruit and the fruit buds for the following year stop growing. And further, that there must be 30 or more good, healthy leaves on the tree for each fruit in order to produce fruit of commercial size, color and quality, and at the same time produce fruit buds for next year's crop. I would further infer that thorough thinning of the fruit so that there would not be more than one fruit to 30 or more leaves on the tree is the first and most important ste in getting satisfactory commercial fruit. Am I right?

MAGNESS:

Yes, that is according to the results we have obtained. Of course to secure a good leaf system we must have proper pruning, the trees must be fertilized the supply of humus in the soil must be maintained and the trees kept in a healthy, growing condition. Spraying to protect the foliage from diseases and insects is essential. As a result of our studies we have a more definite understanding of how the whole tree functions in its growth and fruit production.